

Geologic Sequestration of Carbon Dioxide

Update on USEPA

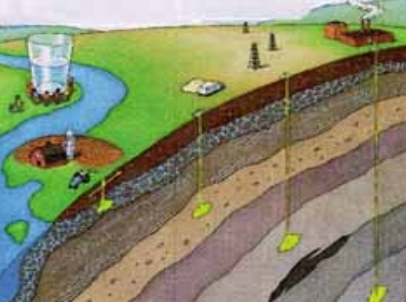
Underground Injection Control Program Activities



Bruce J. Kobelski

**U.S. Environmental Protection Agency
Office of Ground Water and Drinking Water**

**Regional Carbon Sequestration Partnerships Annual Project Review
Pittsburgh, PA
December 12-14, 2007**



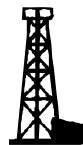
UIC Program Overview

- The Underground Injection Control (UIC) Program protects Underground Sources of Drinking Water (USDW); a USDW is any aquifer or portion of an aquifer that:
 - contains water that is less than 10,000 PPM total dissolved solids
 - contains a volume of water such that it is a present, or viable future, source for a Public Water System
- 33 States have primary enforcement authority (primacy) for the UIC program; EPA and States share program implementation in 7 States; EPA directly implements the entire UIC Program in 10 states
- More than 750 billion gallons of fluid are injected each year. There are between 650,000 and 850,000 injection wells in the U.S.



Class I Wells

deep disposal of manufacturing process waste, mining waste, municipal wastewater, RCRA & radioactive waste



Class II Wells

produced brines, crude oil (storage), drilling fluids and muds, and polymers



Class III Wells

"solution mining" w/ fresh water (salt), sodium bicarb (uranium), or steam (sulfur)



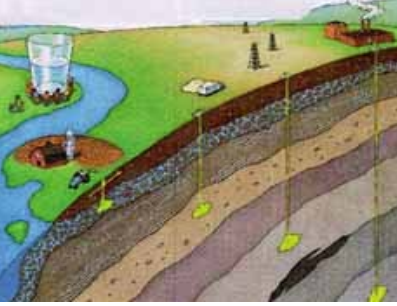
Class IV Wells

Banned except as part of authorized clean-up activities



Class V Wells

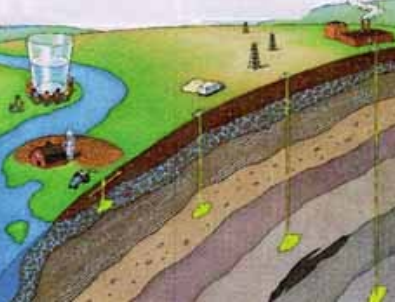
storm water runoff industrial wastewater, car wash water, sanitary waste, agricultural waste, aquifer recharge



UIC Program Background

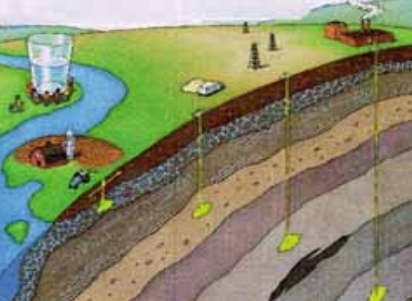
Key Elements

- Geologic Siting
- Area of Review
- Well Construction
- Mechanical Integrity Testing
- Operation and Monitoring
- Well Closure and Post-Closure Monitoring
- Public Participation



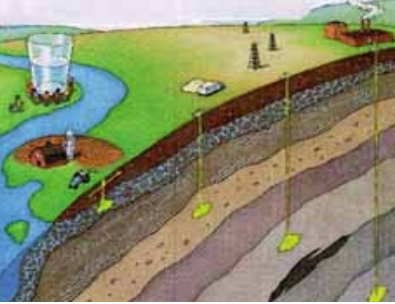
Overview of EPA Activities

- Formed Geologic Sequestration Workgroup (August 2004)
- Determined GS covered by SDWA (January 2006)
- Released the UIC Class V Experimental Technology Well Guidance (draft October 2006; final March 2007)
- EPA and primacy states are receiving, reviewing, and issuing UIC permit applications for DOE geologic sequestration pilot projects (2007 and ongoing)
- Holding Technical Workshops (ongoing)
- EPA's Administrator, Steve Johnson, announced on October 11, 2007, that EPA would develop a **Proposed Rule** for commercial scale GS of CO₂ by Summer 2008



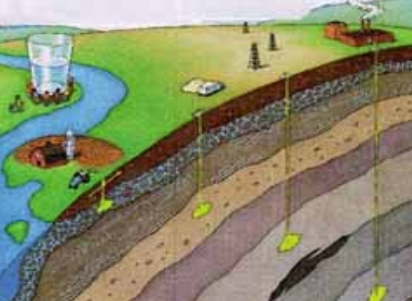
EPA Coordination

- EPA is working closely with DOE in order to leverage existing efforts and technical expertise
- Within EPA, the Office of Water (OW) and Office of Air and Radiation (OAR) are collaborating on all activities related to geologic sequestration in order to:
 - Ensure that cross-programmatic goals are achieved
 - Clarify relationship between various statutes (SDWA, CAA, etc.) and EPA regulations
 - Conduct technical and economic analyses
 - Develop risk management strategies
 - Work closely with key stakeholders to design appropriate regulatory frameworks



Increased Interest in Geologic Sequestration of CO₂

- **Congressional Interest Blossomed in 2007**
 - Numerous House and Senate hearings and proposed legislation
 - GAO study commissioned to examine GS issue
- **Growing Stakeholder Community Interest**
 - **Federal** –EPA’s Offices of Ground Water and Drinking Water, Air and Radiation, and Research and Development; Department of Energy
 - **Federal Advisory Committees** – National Drinking Water Advisory Council (NDWAC) and Clean Air Action Committee (CAAC)
 - **States** –Ground Water Protection Council (GWPC) and Interstate Oil & Gas Compact Commission (IOGCC)
 - **NGOs** –National Resources Defense Council, World Resources Institute, Environmental Defense, among others
 - **Industry Groups** –British Petroleum, American Petroleum Institute, Occidental Petroleum, Schlumberger, Edison Electric Institute, among others



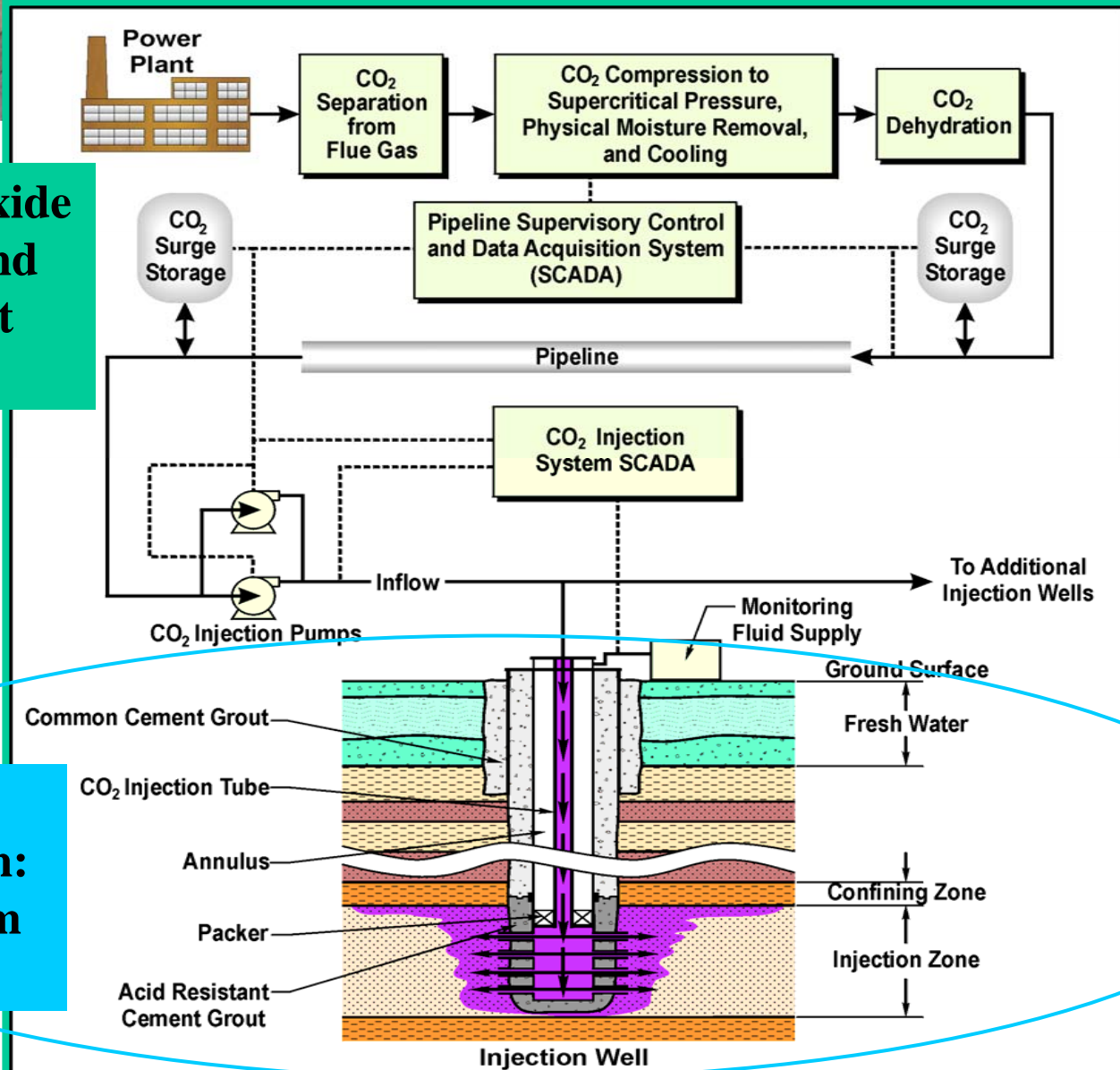
Scope of Proposed Rulemaking

Geologic Sequestration of CO₂

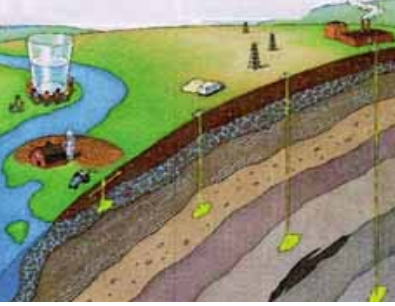
- Scope guided by Safe Drinking Water Act Mandates
- Fluids must be injected in a manner that does not endanger underground sources of drinking water
- UIC program provides a foundation for managing well construction, operation, and closure

Geologic Sequestration of CO₂

Carbon Dioxide Capture and Transport Process

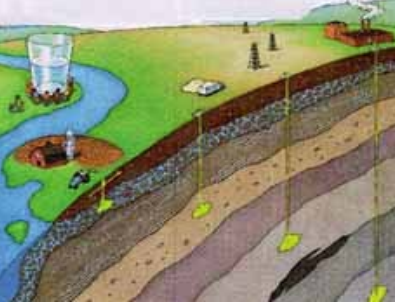


Geologic Sequestration: UIC Program Purview



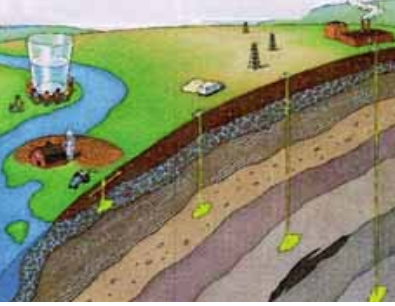
Basis of Findings

- EPA has been tracking activities related to GS of CO₂ for years
- EPA initiated formal stakeholder involvement via meetings and workshops in 2003 and formed an Agency Workgroup
- A sample of recent EPA-sponsored workshops include:
 - UIC State Managers' Workshop
 - Held January 2007 with over 125 attendees
 - Well Construction and Mechanical Integrity Testing Workshop
 - Held March 2007 with over 50 attendees
 - Geologic Setting, Area of Review, and Abandoned Well Technical Workshop
 - Held July 2007 with over 70 attendees
- Planned workshops:
 - Monitoring, Measurement, and Verification (January 16, 2008)
 - Financial Responsibility and Long Term Liability (2008)



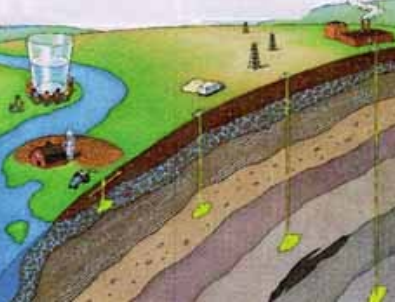
Findings on Key Program Elements Regarding GS

- Geologic Setting:
 - Proper evaluation is the cornerstone of effective and safe GS of CO₂
 - Regulatory standards should be performance based
 - However, additional information is needed on the type and amount of geologic data for appropriate site characterization
- Area of Review (AoR):
 - Existing regulations may not be adequate
 - Fixed radius calculation is inappropriate given the unique properties of CO₂ and injected volumes
 - Need quality data for modeling flow and transport
- Well Construction:
 - Current standards may be sufficient for safe injection of CO₂
 - However, more data on the effects of a CO₂ rich environment on well construction materials is desirable



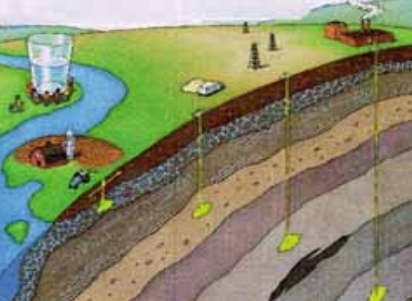
Findings (*continued*)

- Mechanical Integrity Testing (MIT):
 - Additional analysis on existing MIT practices need to be performed
 - New techniques for verifying well integrity should be explored
- Operation and Monitoring:
 - Injection pressures should not exceed fracture pressure
 - Minimum injection depth may need to be established
 - Current program monitoring frequencies may need to be increased



Findings (*continued*)

- Well Closure and Post-Closure Monitoring:
 - Current standards (i.e. plugging) may not be adequate for wells in a CO₂ rich environment
 - Existing regulations provide a certain level of post closure care but adequacy may be in question due to the long term nature of these projects
- Public Participation:
 - Existing regulations provide for public participation
 - However, these requirements may need enhancements due to the large area of review



Ongoing Research on Potential Risks

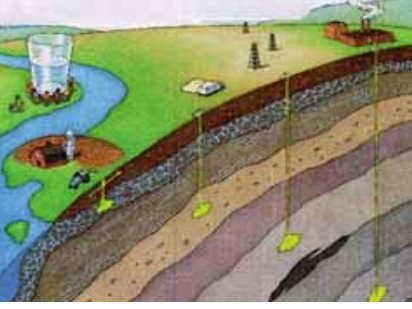
- Organics leaching, dissolution of metals, co-injection of other constituents
- Storage capacity, pressure build-up, alterations to ground water flow regimes
- Key vulnerabilities of CO₂ injection (e.g. human health, sources of drinking water, habitat)
- Decision Tool (will assist in site selection, risk reduction, monitoring plans)
- EPA Technical Workshops on well construction, siting, modeling, reservoir simulation and other topics



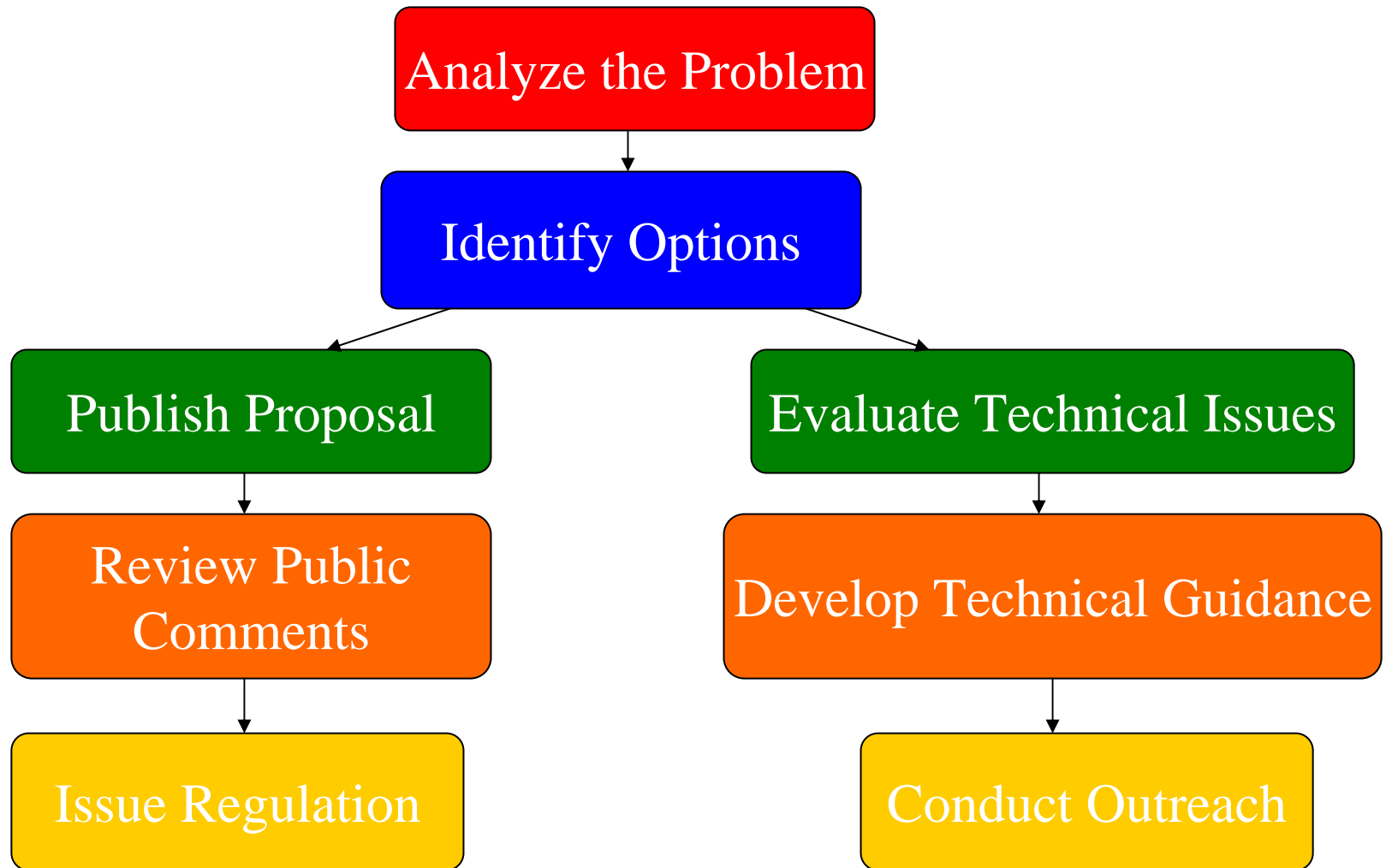
Proposed Rulemaking Process

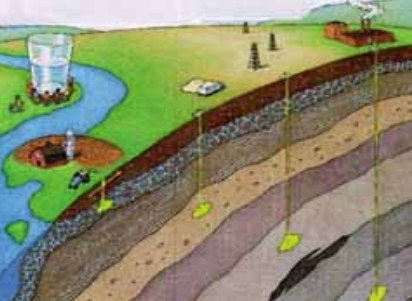
Proposed Rulemaking Phase

1. Form EPA Regulatory Workgroup
2. Collect and analyze data
3. Hold stakeholder meeting(s)
4. Draft documents
 - Economic Analyses
 - Vulnerability Analysis
 - Background Documents
 - Proposed Regulations and Preamble
5. Obtain Agency approval
6. Publish proposal in *Federal Register*
7. Obtain Public Comments



Role of an EPA Workgroup

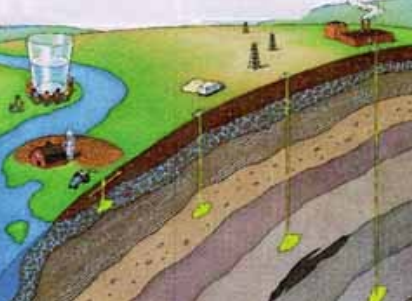




Proposed Rulemaking Process

Final Rulemaking Phase

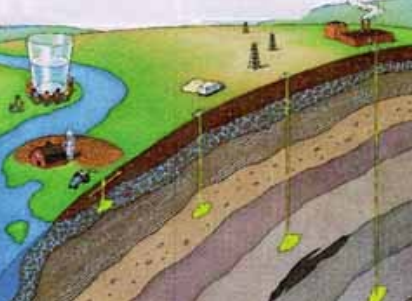
1. Respond to Public Comments
2. Address new data - from GS pilots - with Notice of Data Availability (NODA) if appropriate
3. Draft and revise documents for final rule
4. Obtain Agency approval
5. Publish final rule in *Federal Register*
6. Implementation



Milestones

Geologic Sequestration of CO₂

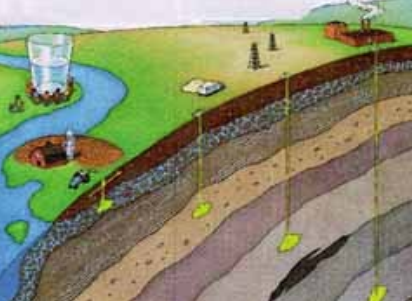
Activity	Milestone
Workgroup Formation & Data Collection and Analysis	Ongoing
Two Stakeholder Meetings	December 2007/February 2008
Interagency Review of Proposed Rule	Late May - Early June 2008
Administrator's Signature of Proposed UIC Rule	July 2008
Public Comment Period for Proposed Rule	July – October 2008
Notice of Data Availability (if appropriate)	2009
Final UIC Rule for GS of CO ₂	Late 2010 / Early 2011



Successful Deployment of CCS

- While CCS is not a “silver bullet,” it is a key climate change mitigation technology
- Ensuring that permitting regulations are in place will enable commercial-scale CCS projects to move forward
- Clear guidelines will reduce uncertainty for project proponents
- Past experience gives us confidence that we can work closely with key stakeholders to develop well-designed regulatory approaches

“By harnessing the power of geologic sequestration technology, we are entering a new age of clean energy – where we can be both good stewards of the Earth, and good stewards of the American economy.” - EPA Administrator Stephen L. Johnson



Questions and Discussion

Proposed UIC Rule for GS of CO₂

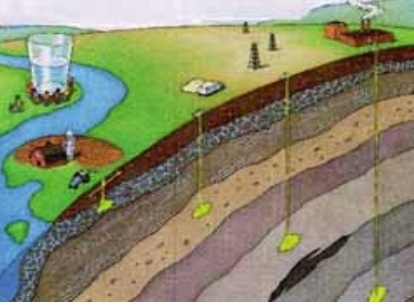


Questions?



More information about the UIC Program

- EPA Geologic Sequestration of Carbon Dioxide Website –
http://www.epa.gov/safewater/uic/wells_sequestration.html
- Code of Federal Regulations: Underground Injection Control Regulations 40 CFR 144-148 –
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=d6ee71a544eca89c533c825135913f13&c=ecfr&tpl=/ecfrbrowse/Title40/40cfrv22_02.tpl

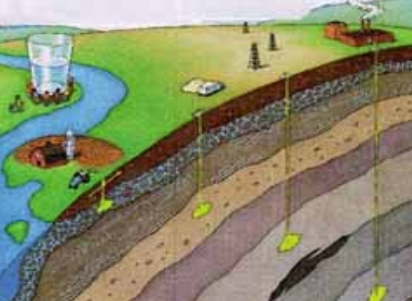


Background Slides



UIC Program Background *Framework*

- The Safe Drinking Water Act (SDWA) requires EPA to develop minimum federal regulations for state and tribal Underground Injection Control (UIC) Programs to protect underground sources of drinking water
- The UIC Program regulates underground injection of a *all fluids* – liquid, gas, or slurry
- Natural gas (hydrocarbon) storage, oil & gas production, and some hydraulic fracturing are exempt from UIC requirements
- The existing UIC program *provides a regulatory framework for the Geologic Sequestration of CO₂*



UIC Program Background

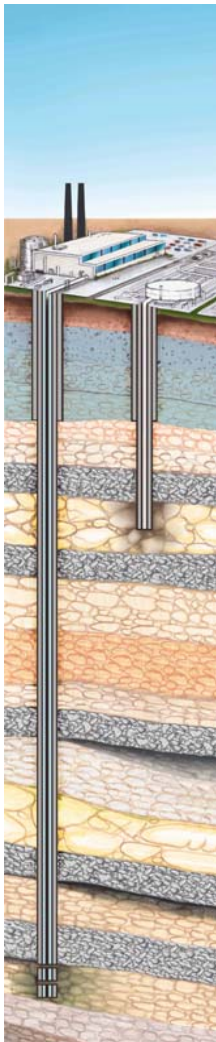
Well Classes

- **Class I** – Technically sophisticated, stringently regulated deep injection wells with detailed siting, monitoring, and closure requirements. Examples include:
 - Wells that accept hazardous fluids
 - Wells that accept non-hazardous industrial fluids
 - Wells that accept municipal wastewater
- **Class II** – Wells used by oil and gas operators for waste fluid disposal, enhanced recovery (ER), and hydrocarbon storage
- **Class III** – Wells associated with solution mining (e.g., extraction of uranium, copper, and salts)
- **Class IV** – Wells used to inject hazardous or radioactive waste into or above a USDW
- **Class V** – Any injection well that is not contained in Classes I to IV; Initial GS pilot projects permitted as Class V experimental wells

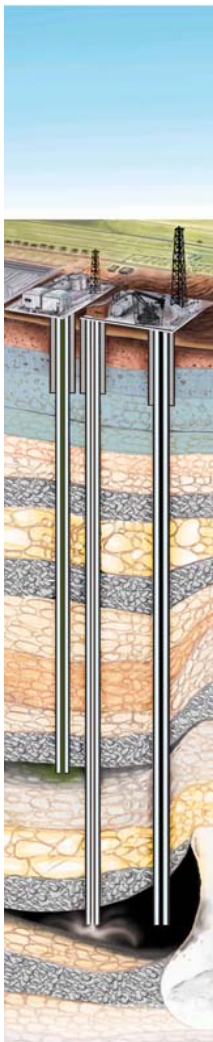
UIC Program Background

Well Classes

Class I



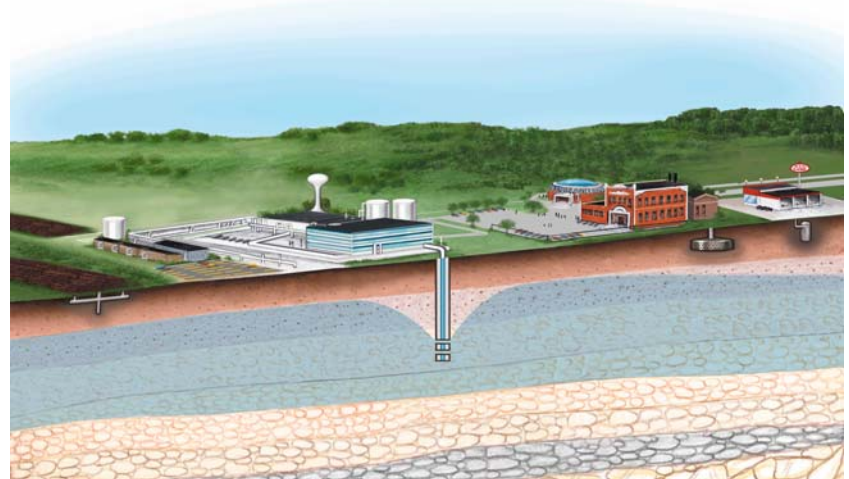
Class II



Class III



Class V



UIC Program Background

Implementation

- Thirty-three States have primary enforcement authority (primacy) for the UIC program.
- EPA and States share implementation of programs in 7 states
- EPA directly implements the program in 10 states

